

Applicant(s): Ares Rosakis, et al.

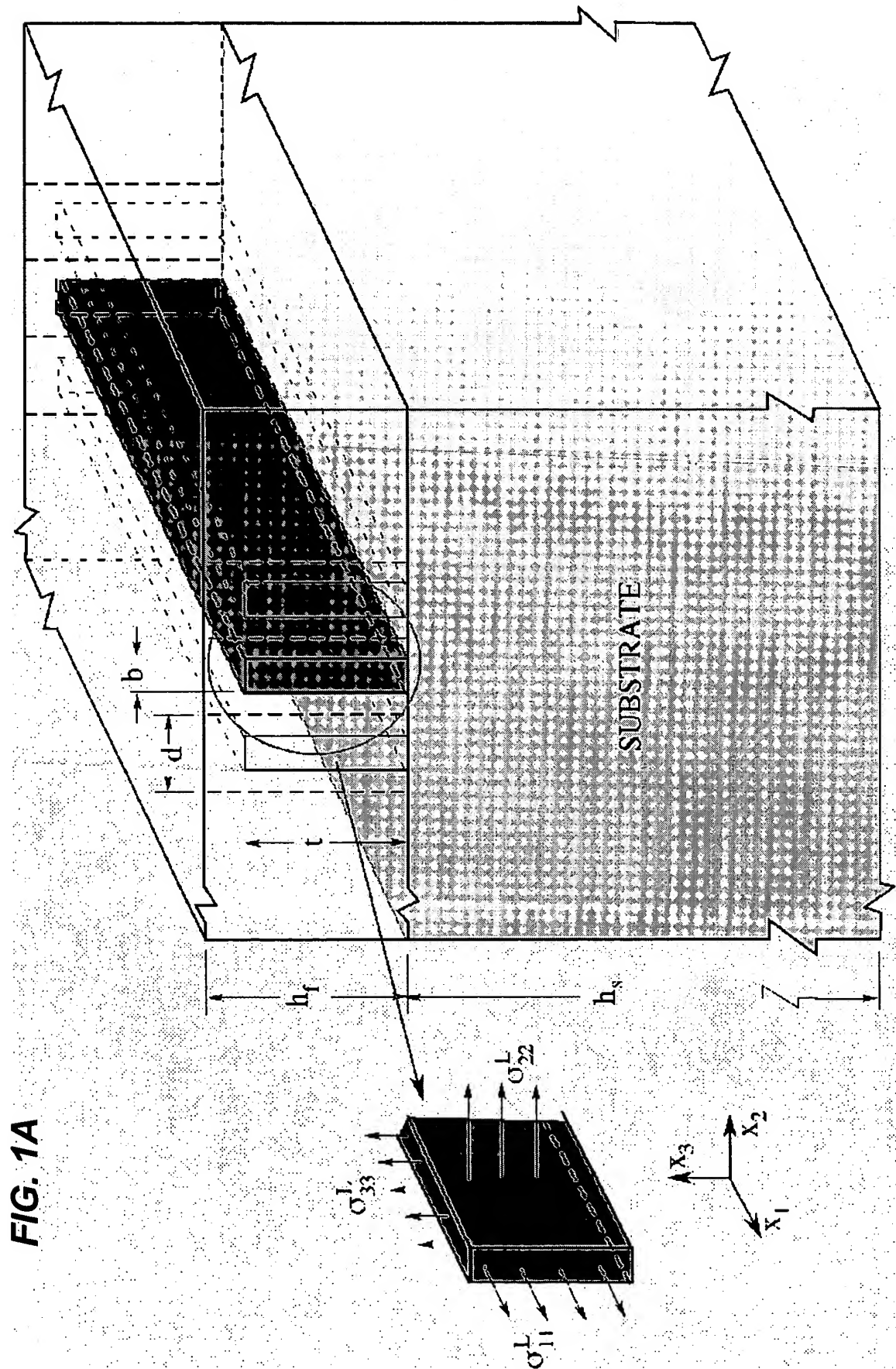
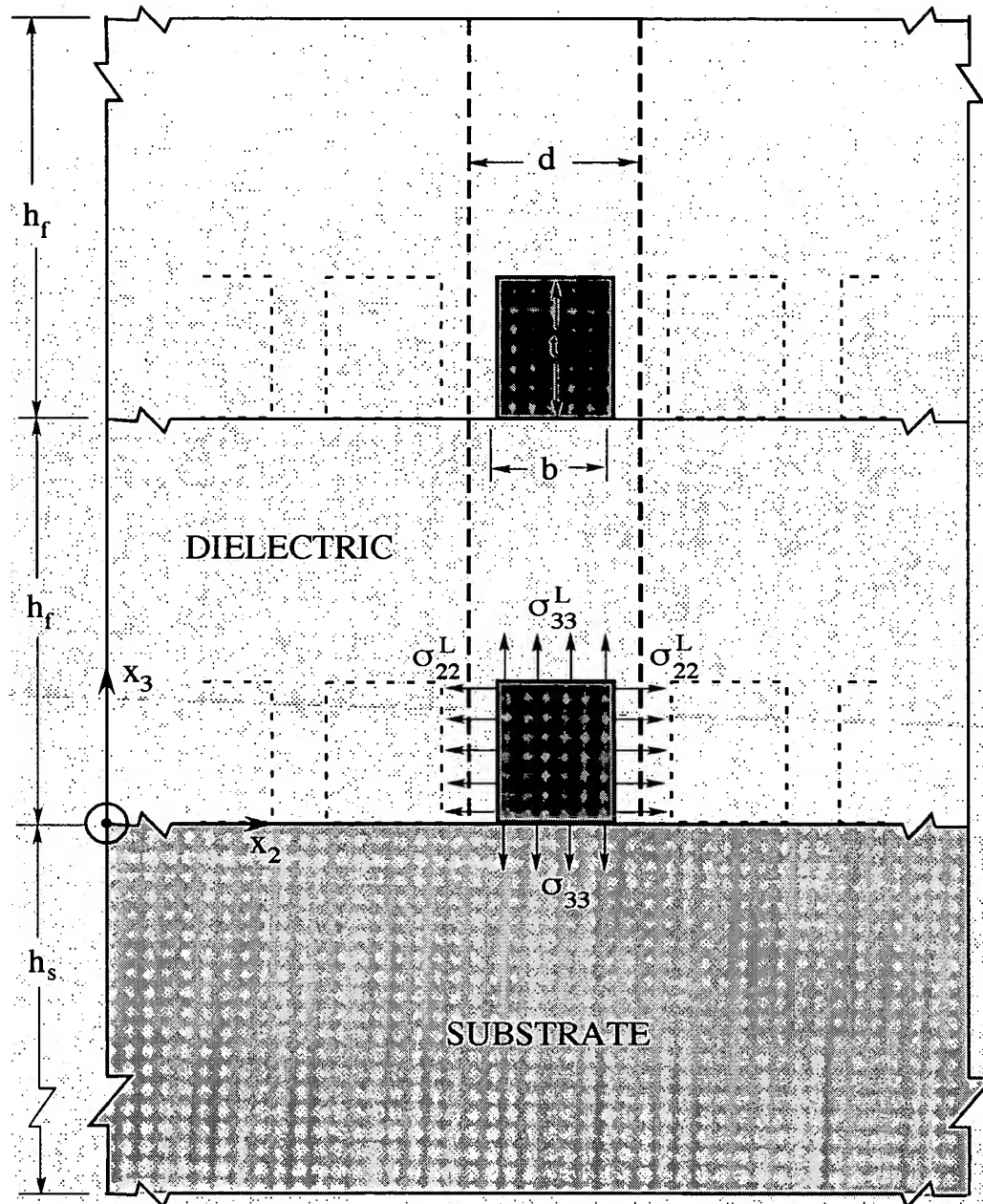
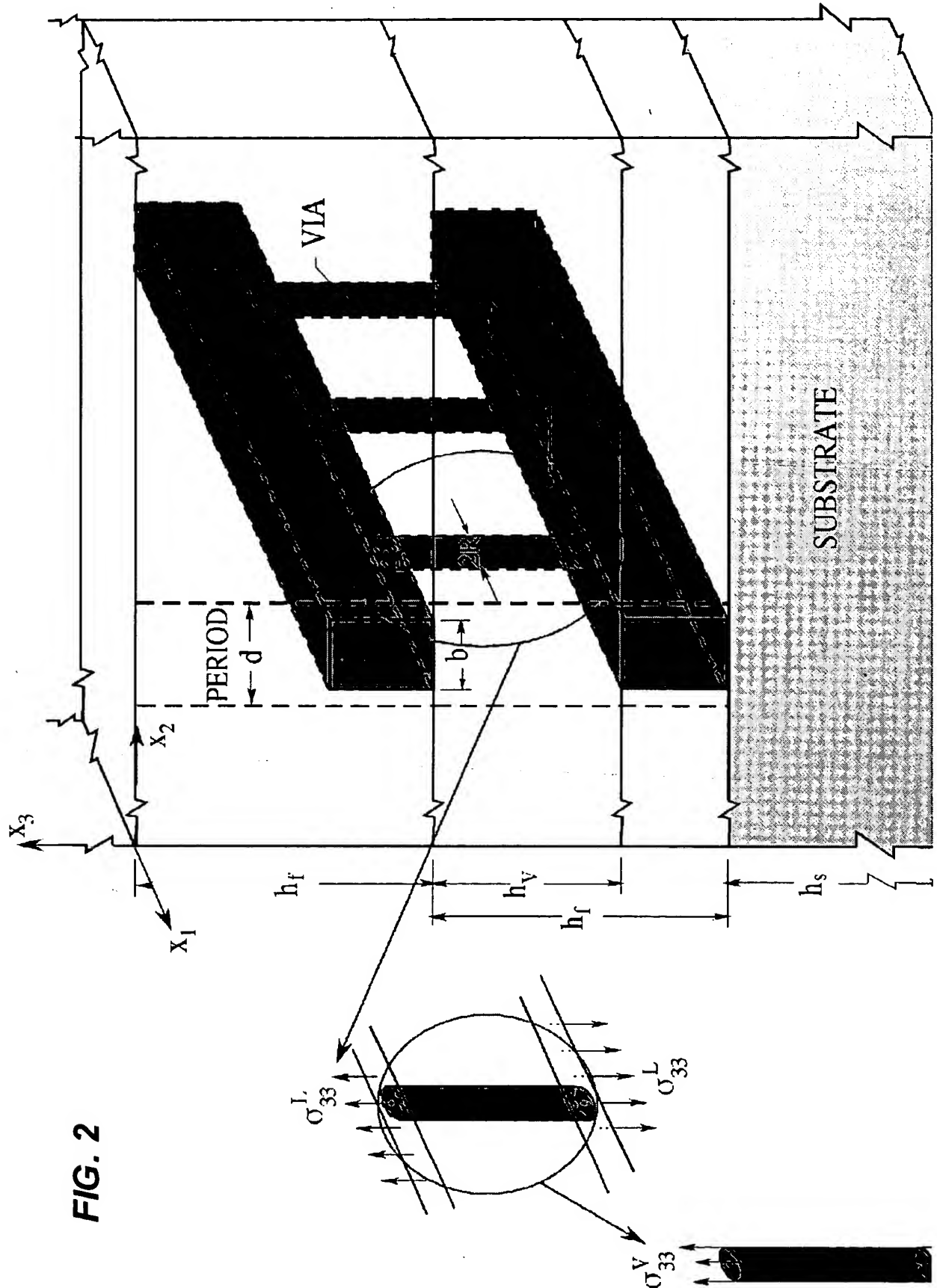
ANALYSIS AND MONITORING OF STRESSES IN
EMBEDDED LINES AND VIAS INTEGRATED ON
SUBSTRATES

FIG. 1B



$E_{Cu}=110\text{GPa}$, $\alpha_{Cu}=17\times 10^{-6}/^{\circ}\text{C}$ $E_{TEOS}=59\text{GPa}$, $\alpha_{TEOS}=1\times 10^{-6}/^{\circ}\text{C}$
 $E_W=410\text{GPa}$, $\alpha_W=4.3\times 10^{-6}/^{\circ}\text{C}$ $E_{SILK}=2.45\text{GPa}$, $\alpha_{SILK}=66\times 10^{-6}/^{\circ}\text{C}$

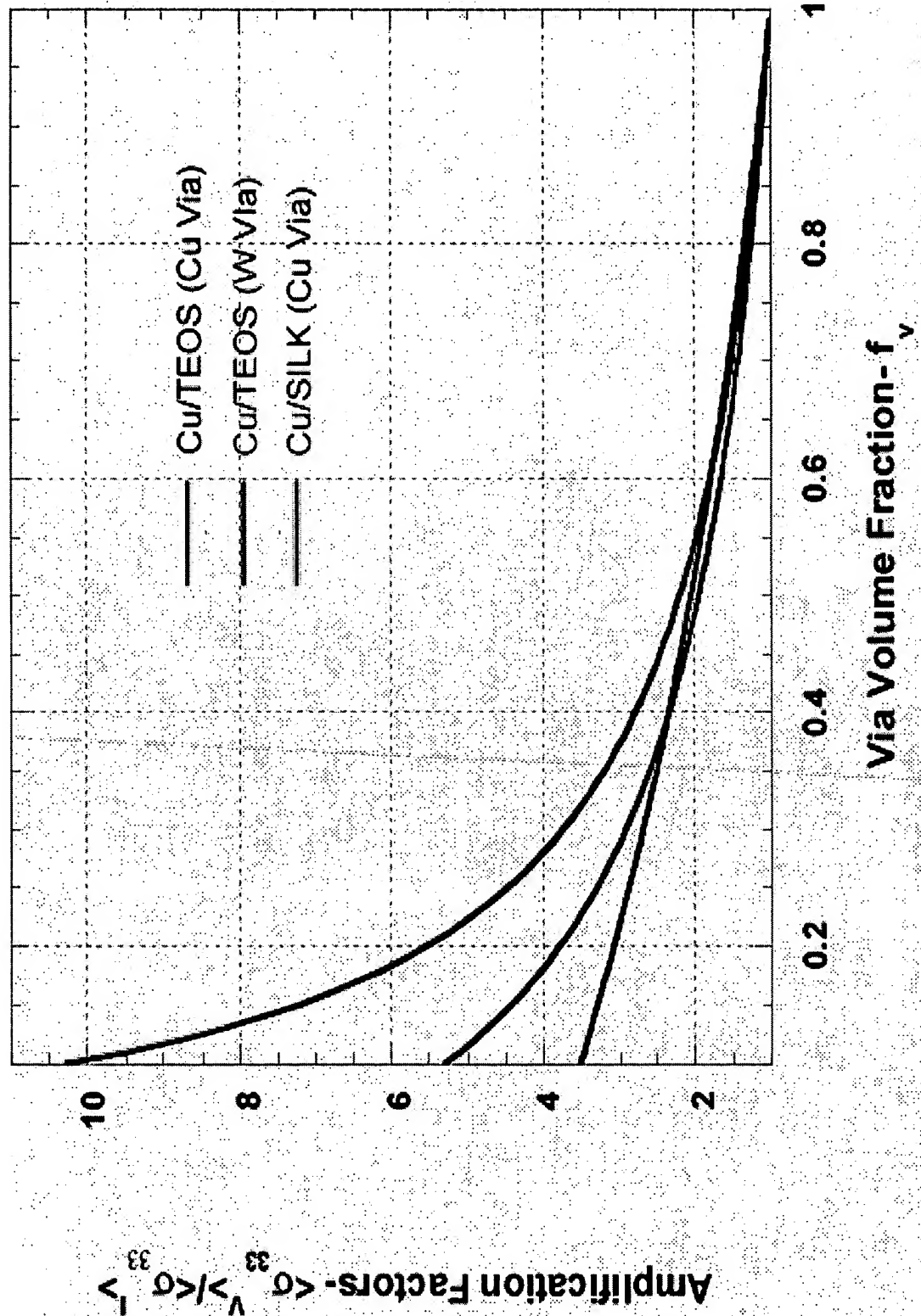
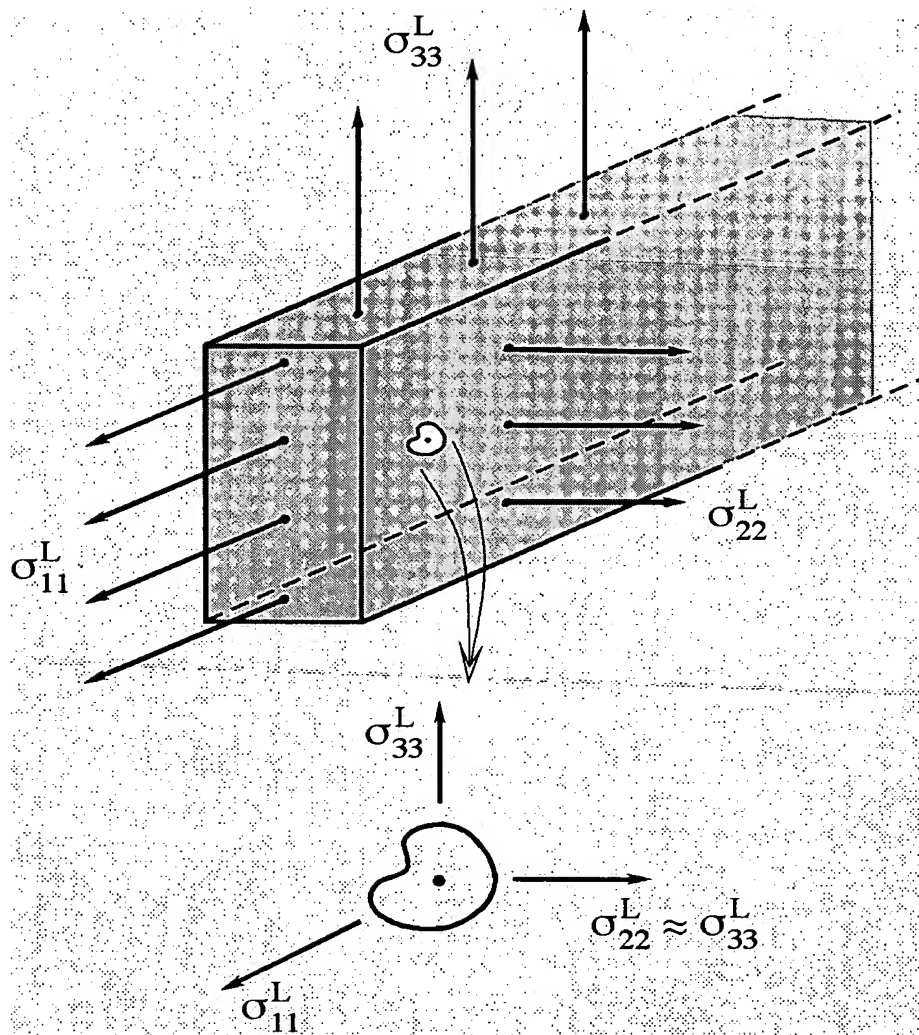
FIG. 3

FIG. 4

Materials: Cu lines, TEOS dielectric, Si Substrate
Geometry: $t=0.5\mu\text{m}$, $h_s=525\mu\text{m}$, $b=0.4\mu\text{m}$, $f_i=b/d$
Criterion: $\alpha=2$ or 3 , $\sigma_y=293\text{MPa}$ (using Hall-Petch)

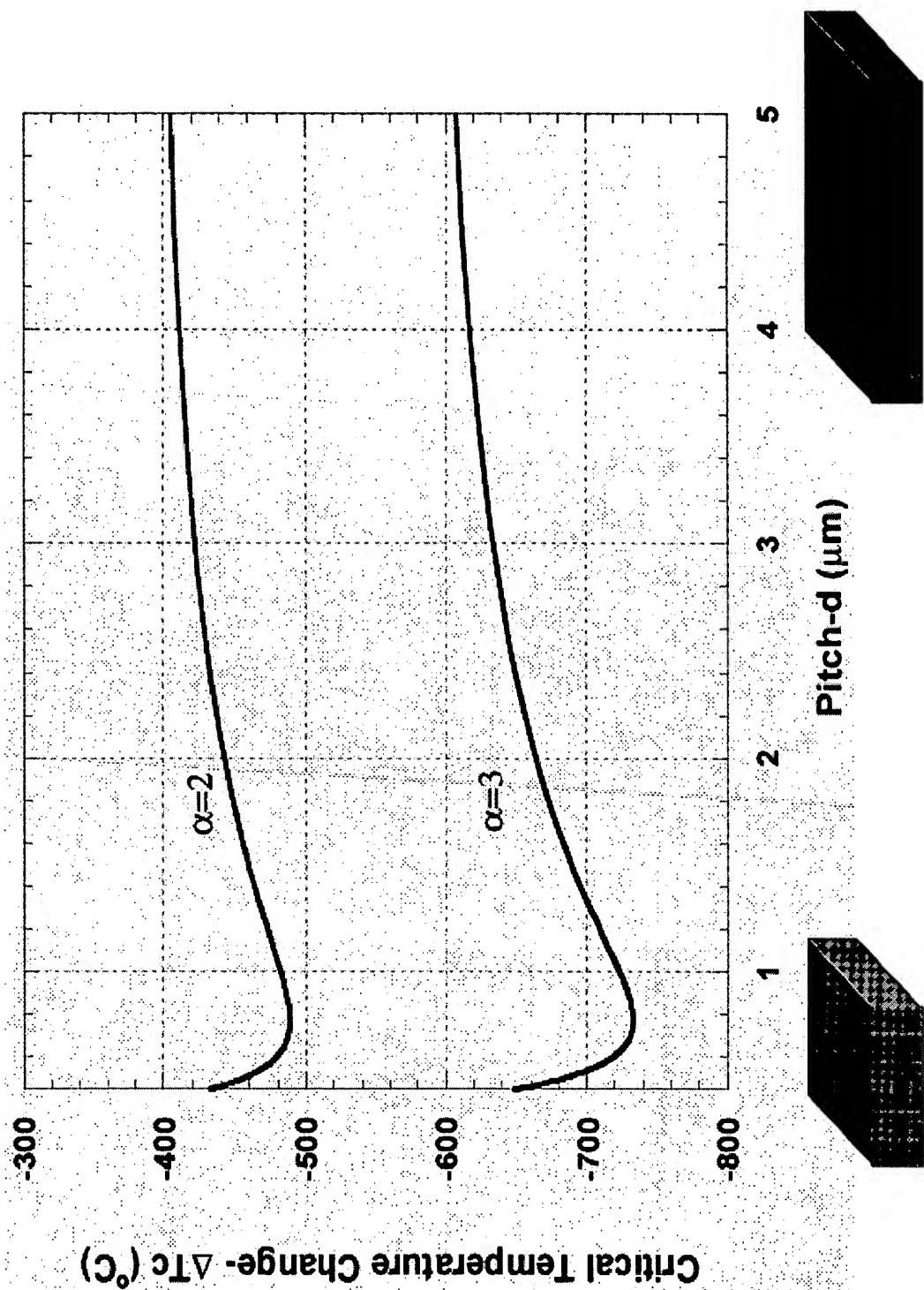
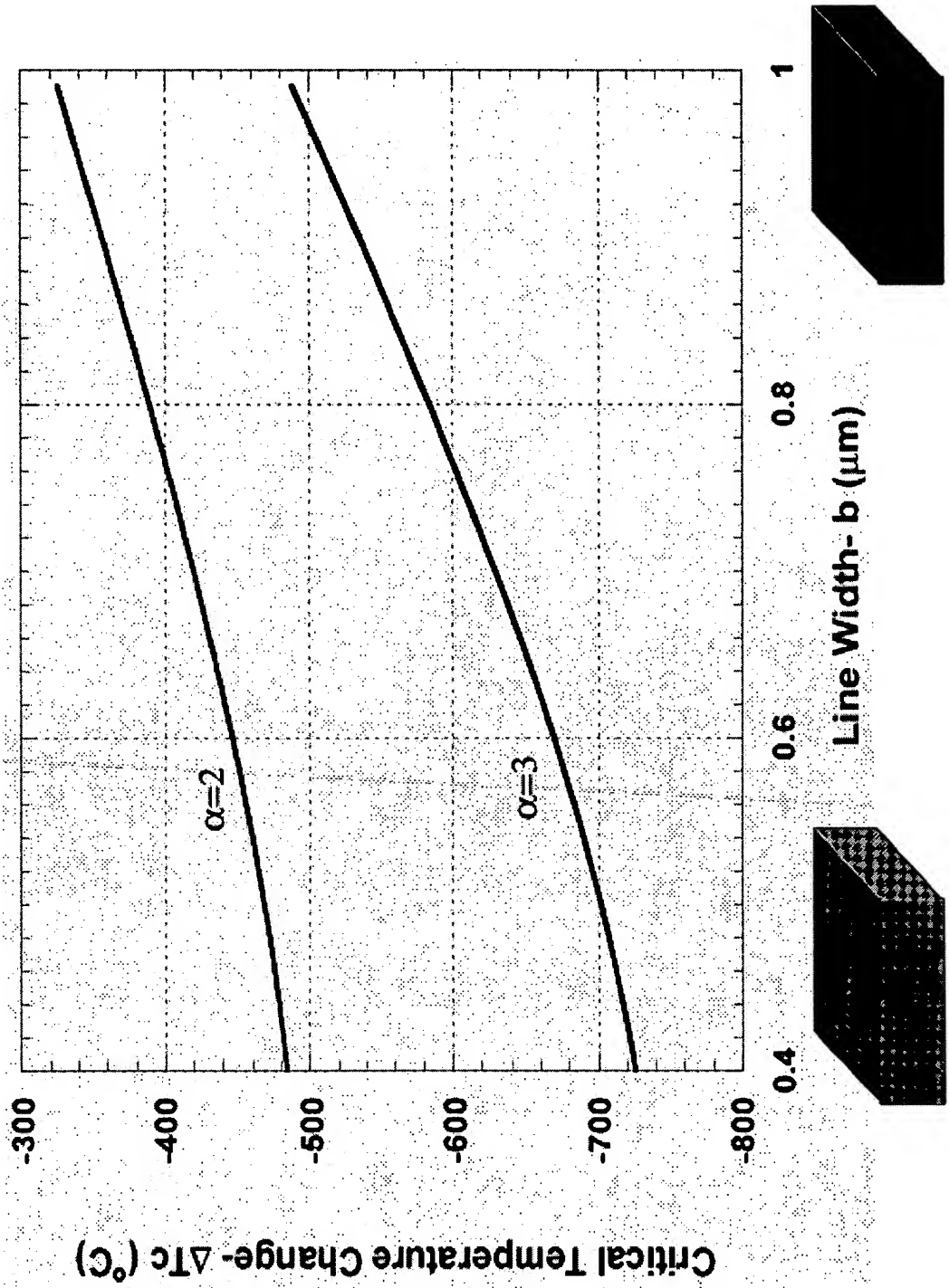


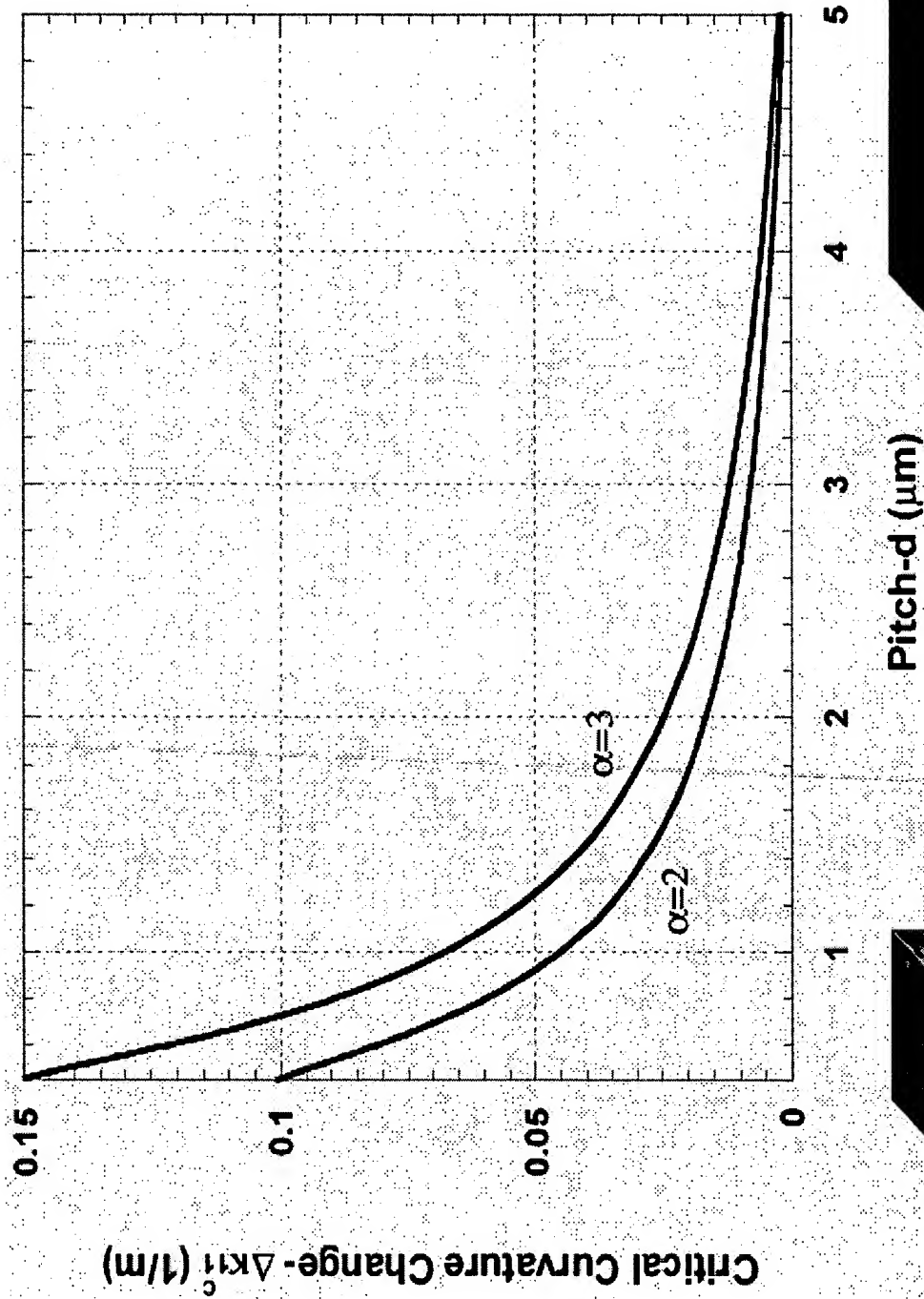
FIG. 5

Materials: Cu lines, TEOS dielectric, Si Substrate
Geometry: $t=0.5\mu\text{m}$, $h_s=525\mu\text{m}$, $d=1.0\mu\text{m}$, $f_l=b/d$
Criterion: $\alpha=2$ or 3 , $\sigma_y = 26.9[1 + 6.64\{(t+b)/2\}^{-0.5}] \text{ MPa}$

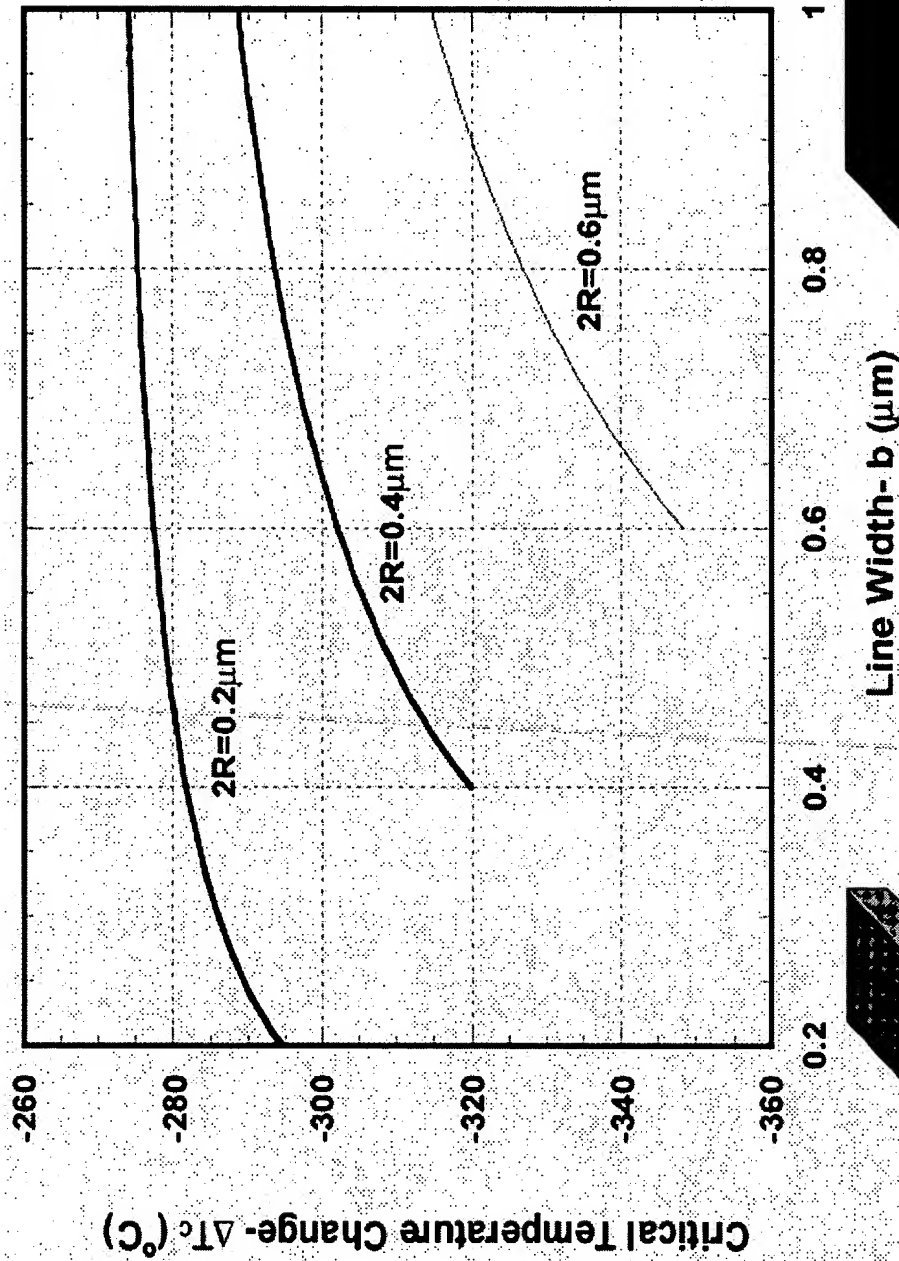
FIG. 6

Materials: Cu lines, TEOS dielectric, Si Substrate
Geometry: $t=0.5\mu\text{m}$, $h_s=525\mu\text{m}$, $b=0.4\mu\text{m}$, $f=b/d$
Criterion: $\alpha=2$ or 3 , $\sigma_y=293\text{MPa}$ (using Hall-Petch)

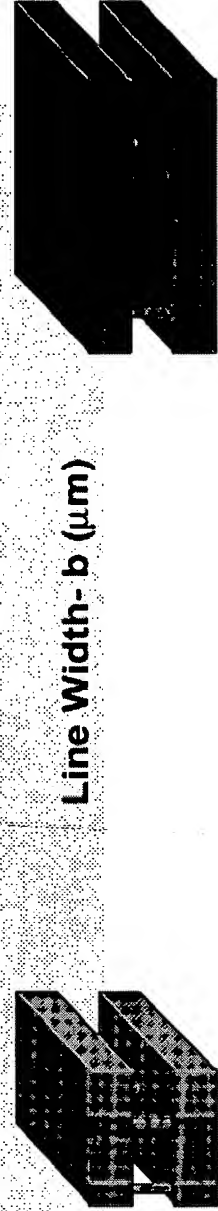
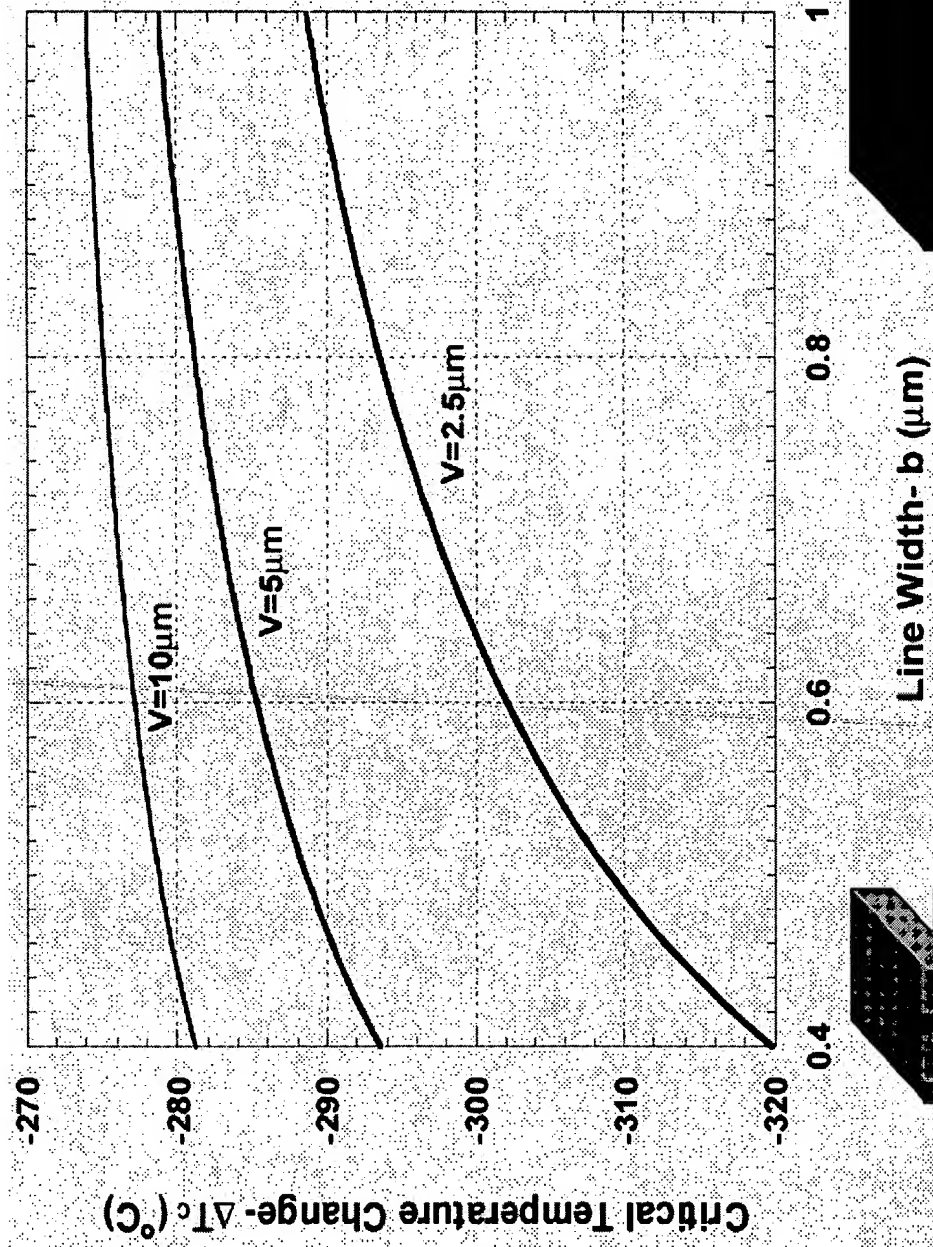
FIG. 7



Materials: Cu lines/vias, TEOS dielectric, Si Substrate
Geometry: $t=0.5\mu\text{m}$, $h_s=525\mu\text{m}$, $f_r=b/d=0.5$, $V=2.5\mu\text{m}$, $f_v=\pi R^2/bV$
Criterion: $\alpha=3$, $\sigma_y=293\text{MPa}$ (using Hall-Petch)

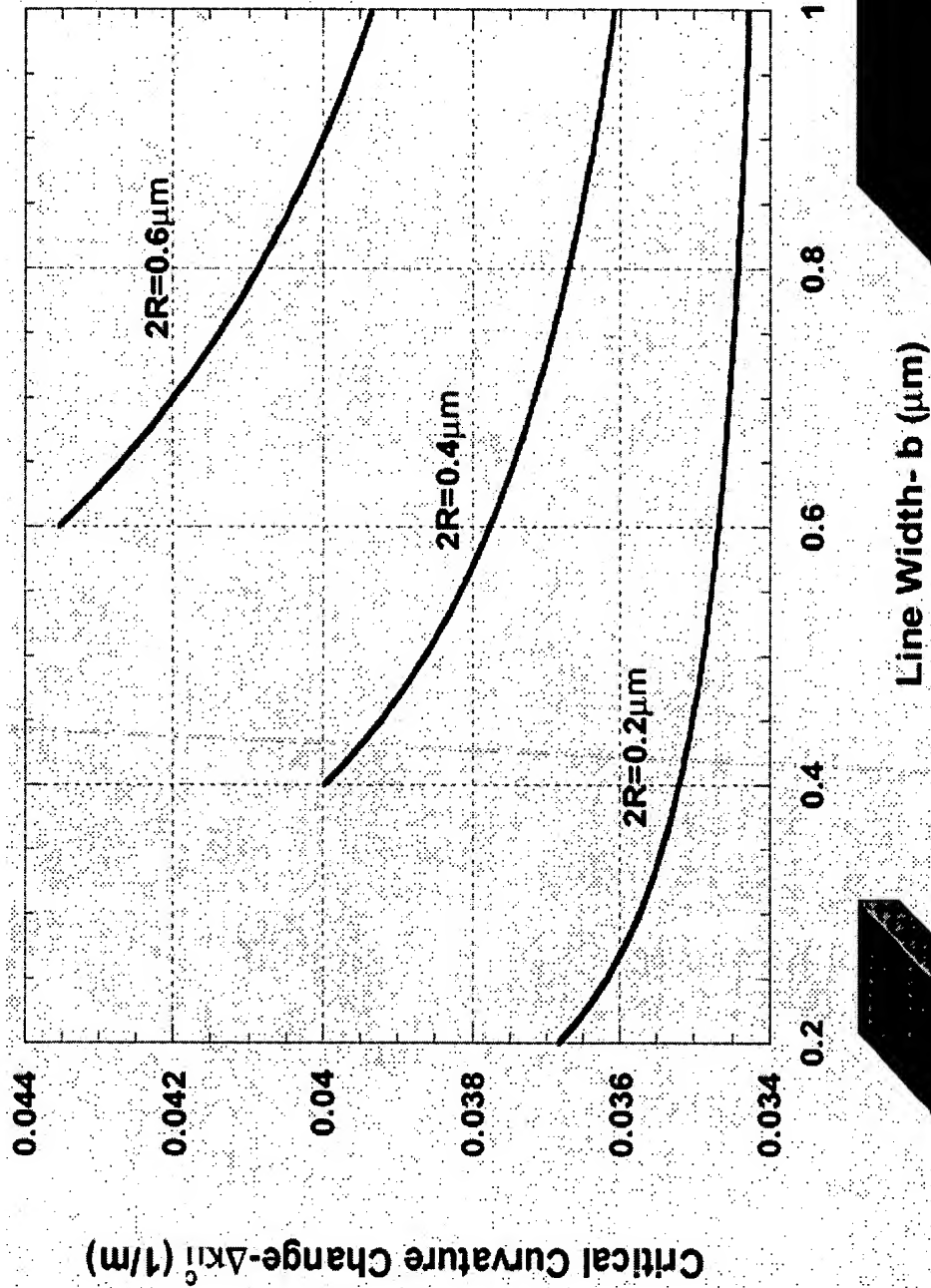
FIG. 8

Materials: Cu lines/vias, TEOS dielectric, Si Substrate
Geometry: $t=0.5\mu\text{m}$, $h_s=525\mu\text{m}$, $f_r=b/d=0.5$, $2R=0.4\mu\text{m}$, $f_v=\pi R^2/bV$
Criterion: $\alpha=3$, $\sigma_y=293\text{MPa}$ (using Hall-Petch)

FIG. 9

Materials: Cu lines/vias, TEOS dielectric, Si Substrate
Geometry: $t=0.5\mu\text{m}$, $h_s=525\mu\text{m}$, $f_l=b/d=0.5$, $V=2.5\mu\text{m}$, $f_v=\pi R^2/bV$
Criterion: $\alpha=3$, $\sigma_y=293\text{MPa}$ (using Hall-Petch)

FIG. 10



Materials: Cu lines/vias, TEOS dielectric, Si Substrate
Geometry: $t=0.5\mu\text{m}$, $h_s=525\mu\text{m}$, $b=0.4\mu\text{m}$, $f=b/d$, $2R=0.4\mu\text{m}$, $V=2.5\mu\text{m}$, $f_v=\pi R^2/bV=0.125$
Criterion: $\alpha=3$, $\sigma_y=293\text{MPa}$ (using Hall-Petch)

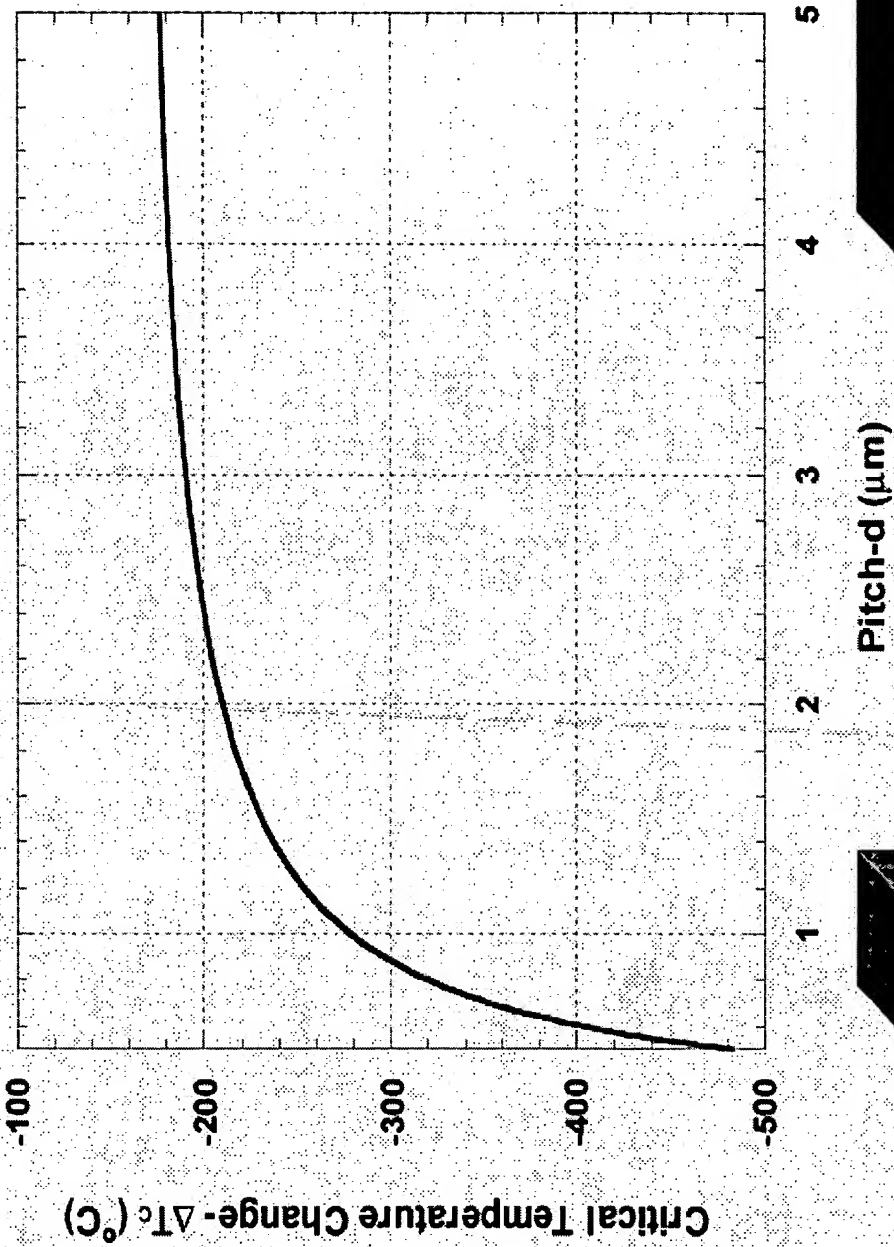


FIG. 11



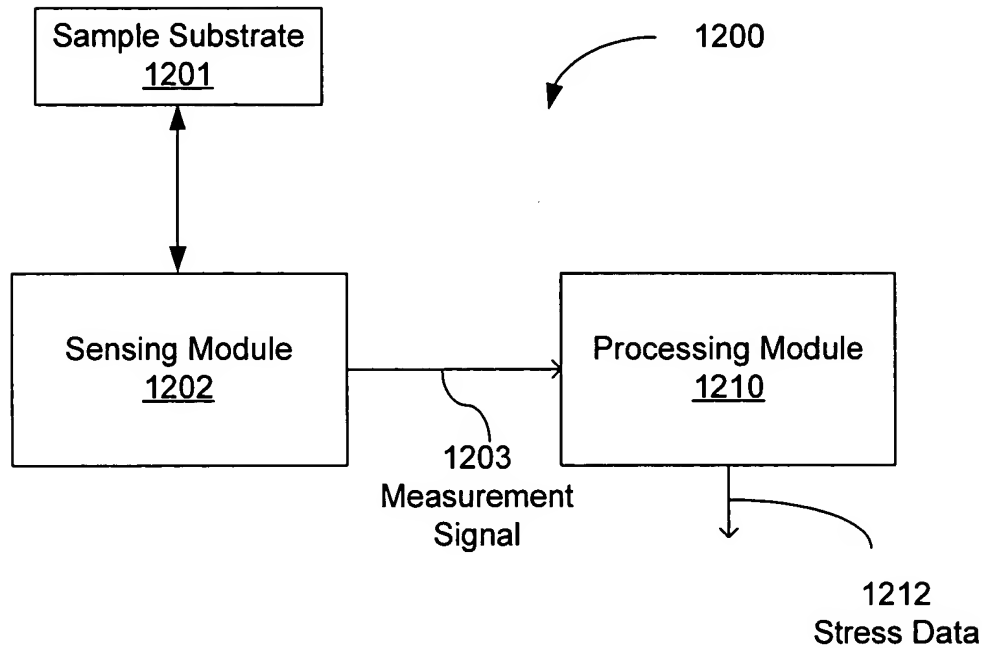
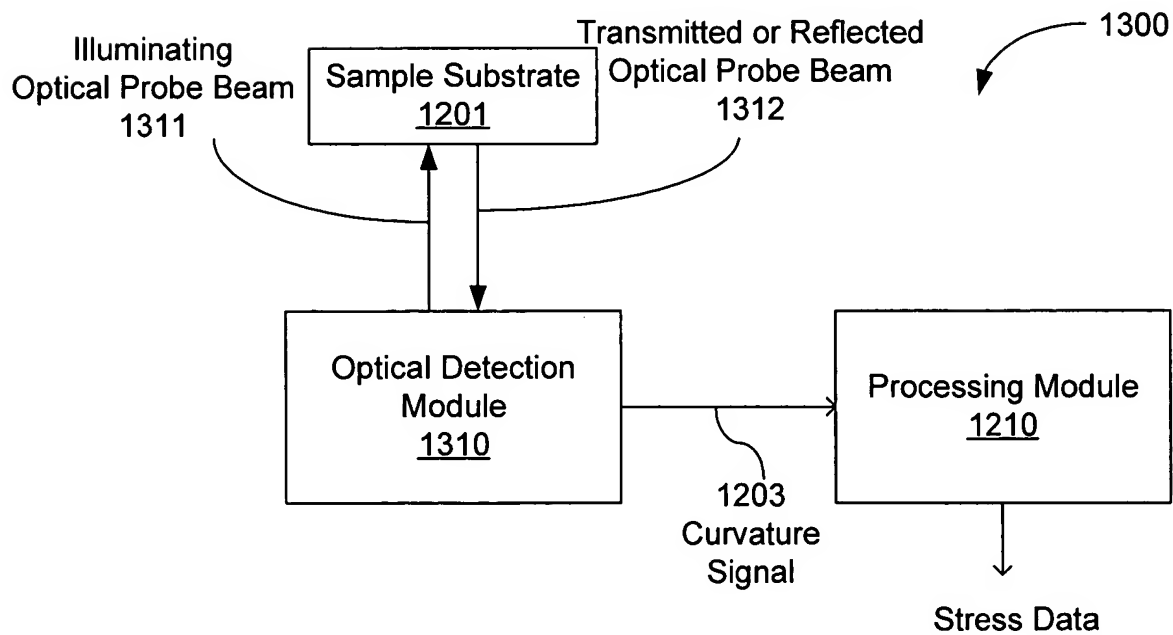
FIG. 12**FIG. 13**

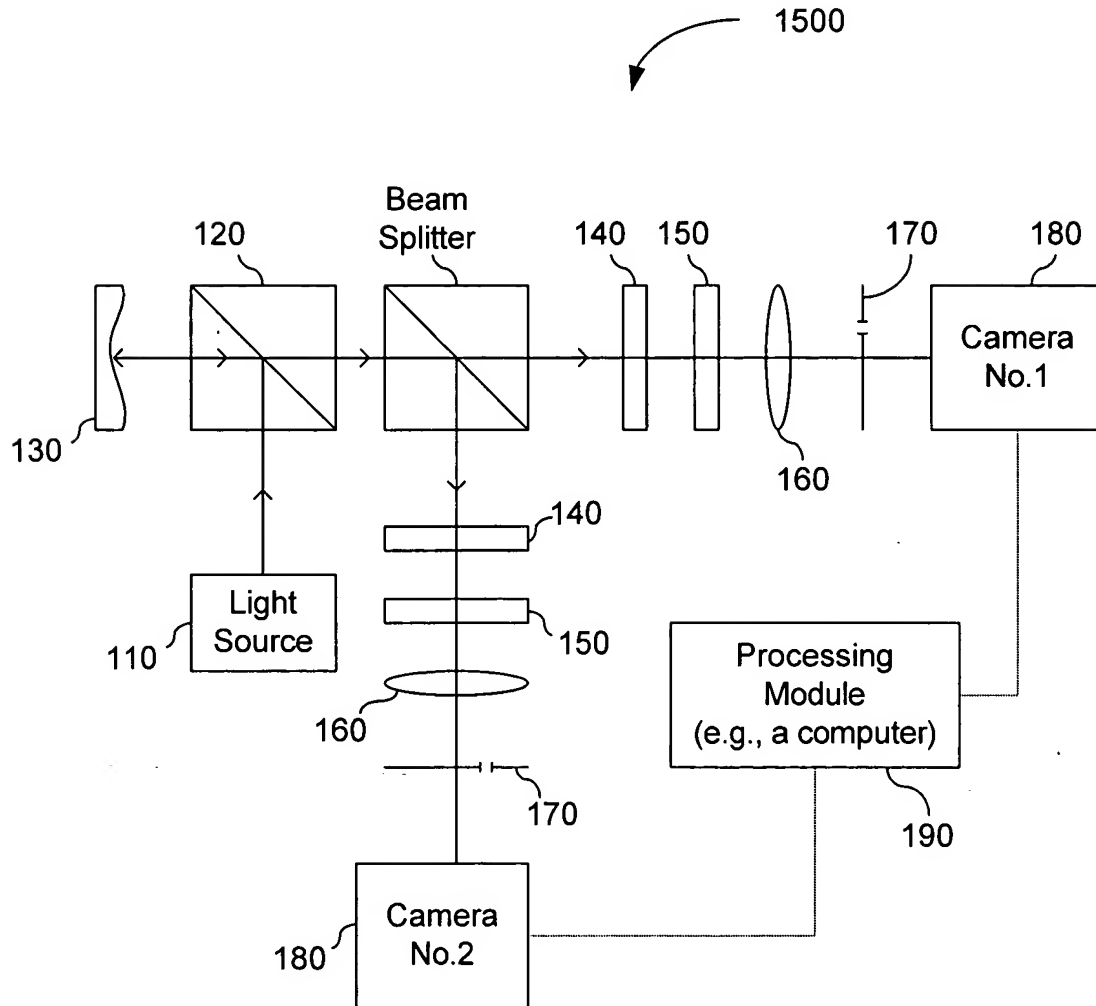
FIG. 15

FIG. 16